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# *ANTI-GRAVITY POWER*

*Aero Space Propulsion System of the Future*

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# *Anti-Gravity Power*

## INTRODUCTION

Gravity control is at the forefront of scientific research today. This document contains summaries compiled from hundreds of the latest reports by the world's leading gravity researchers. It contains gravity experiments and theories, matter and energy concepts, nuclear and universe structure theories, etc. It is hoped that this book will be of some help in the broadcasting of gravity knowledge so that this field can be furthered more quickly and lead to a breakthrough in the utilization of gravity control as an aerospace propulsion method.

During the author's 14 years of independent gravity research, he has never failed to find this to be a fascinating field. In the opinion of the writer, practical gravity control will be possible within the next 5 years. This prediction was derived from noting the rapid acceleration of present day scientific technology. Innovations are not increasing at a linear rate, but more on an exponential rise. Murtaugh prophesies that a gravity control machine or some new means of propulsion (possibly using laser technology) will be invented by the early 1970's. He arrived at this timing by observing the fact that we will need a new type of propulsion, and the economic incentive will be of sufficient magnitude to support a rapid development of a new technology.

In this report, you will find no formulas pertaining to the measurement of the gravity field. Any physics book can give you that information. You will find no "pat answers" herein, because as of yet there are none. We are not trying to discover how to measure gravity, we are trying to discover what it is, what causes it, what is its mechanism, how can it be controlled? Consequently, this report contains a vast number of theories as to the mechanism of the gravity effect or some related phenomena which may shed light on the gravity research. You will find many theories which are in direct conflict with each other in this report. This must be. Any one of these theories may lead a researcher onto the right path which will give as a result, gravity control. Somewhere a shred of evidence exists which will tie some loose ends together and we will grasp the final product.

You will note that theories pertaining to an ether are included herein. This is because the writer feels that ether theories are not yet a dead issue. Many effects can be readily understood and accepted if an ether concept is used for visualization. As a noteworthy item, the assumption of an ether capable of absorbing a certain minute quantity of energy can be used to predict two effects derived initially from other considerations. These two effects are: (1) The extra shift of the elliptical orbit of the planet Mercury predicted from the relativity equations, and (2) The red shift of the spectral lines of distant galaxies usually attributed to an expanding universe. Also, consider this: calculations show that the centrifugal force of the earth in its orbit would require a steel cable 5000 miles in diameter to keep it from flying into space. And yet, "empty space" holds the sun and the earth together!

Any universe model, be it based on relativity, ether, or something else, is used basically to set up a mathematical "game" which is manipulated to fit the external facts. We then attempt to play this game as far as it will go, watching for new phenomena along the way. Therefore, it makes no difference which universe model is used to derive the equations that will enable us to design a practical gravity control aerospace drive. The end result is the same.



The more we study gravitation, the more there grows upon us the feeling that there is something peculiarly fundamental about this phenomenon to a degree that is unequaled among other natural phenomena. Its independence of the factors that effect other events in nature and its dependence only upon mass and distance suggest that its roots avoid things superficial and go deep down into the very essence of matter and space.

A vehicle powered by a gravity control method would actually have only one item different from present day space craft. This of course is the propulsion system. All other technologies, life support, navigation, structural materials, communications, etc., would be direct derivations from those in use today. But what a propulsion system! According to many physicists it would not only drive the vehicle it would also eliminate inertial effects on the vehicle and the crew! This would mean unlimited accelerations in any direction including small-radius turns. For a tight turn, a force field would exactly counterbalance the centrifugal force so that neither the vehicle nor the passengers would be subject to uncomfortable strains.

High accelerations could be used to attain relativistic speeds within a reasonably short time thereby making possible space travel not only to distant solar systems within our own Milky Way galaxy, but exploration of at least some of our nearby neighboring galaxies. Since the speeds would be near that of light, these giant steps could be easily made within the life span of one generation of crew members. However, it must be realized that the earth would have gone thru many generations by the time the excursion had returned, and some precautions will be necessary to provide for this time difference. As an example, a crew member may want to have his immediate family with him on a trip to insure reasonable adjustment to earth life on his return.

But what of the effect of gravity control machines here on earth? As a starter, all other forms of transportation would become obsolete. As efficient 3-dimensional travel becomes practical, automobiles, trucks, railroads, ships and even airplanes would be considered impractical. Highways, bridges, railroad tracks, harbors and airports as we know them would no longer be needed and therefore would vanish from our landscape.

Transformation of our cities would be phenomenal and can only be guessed at. Intra-city transportation would be by air thereby eliminating the need for streets. No limits on building height would be necessary as deliveries could be made at any floor with ease, and structural problems of massive buildings would be alleviated by adequate application of gravity control in the architecture. Many factors affecting the location of cities (such as good highways, waterways, etc.) would no longer prevail as supplies would be readily available from any part of the country within minutes and with great efficiency. Indeed, cities might not remain at ground level at all, and many may be built as islands in the sky. Power would be no problem, with anticipated energy from thermonuclear fusion.

True suburban living would become a reality with most families owning a high-speed gravity propulsion transporter, able to land in any small cleared area with little noise and great safety. These vehicles would produce no air pollution, being powered by electrical energy derived from nuclear batteries.



A typical commuter might live 200 miles or more from work in a secluded mountain setting of his choice. After morning breakfast, he would stroll to his back yard, step into his anti-gravity car and be at work in a few minutes. In fact, his home itself may be highly mobile with the capability of quickly moving from area to area, a mobility which today's trailer homes only hint at. Picture a home capable of being moved from a seashore to a favorite mountain lake and then to a spot along a quiet river or a secluded desert hideaway all within minutes after the thought occurred to you. This is well within the capability of a home built around a gravity control propulsion unit.

Even with the projections of the future we have made here, we have truly barely scratched the surface of the developments possible with gravity control. As seen in the classical example of the laser, new inventions have an unpredictability of uses. We have an exciting future to look forward to!

To those of you who have the necessary funds and facilities available for experimentation, the following is an outline of a research program which the author recommends for familiarization and extension of present knowledge in the anti-gravity research program. Since the Biefeld-Brown effect seems to be the simplest approach to gravity control, the Townsend Brown experiments are recommended as a starting point and from there the expansion of the experiments as far as possible:

- (1) Conduct the basic pendulum experiment, manipulating those variables necessary to make the unit most efficient.
- (2) Construct a 1' to 3' diameter working model, maximizing the efficiency of all components. This should be a flyable mechanism but will probably have an external power source.
- (3) Construct a full-scale prototype!

To those of you who do not wish to engage in the actual experimentation, the Anti-Gravity Research organization would be happy to receive any and all theories, ideas and concepts related to anti-gravity, whether it be only the seedling of an idea or a long thought out treatise. The author wishes to take this time to extend his many thanks to those researchers who have been kind enough to allow him to study their work.

The Creator uses many instruments to direct the universal field and harmonize this universe.

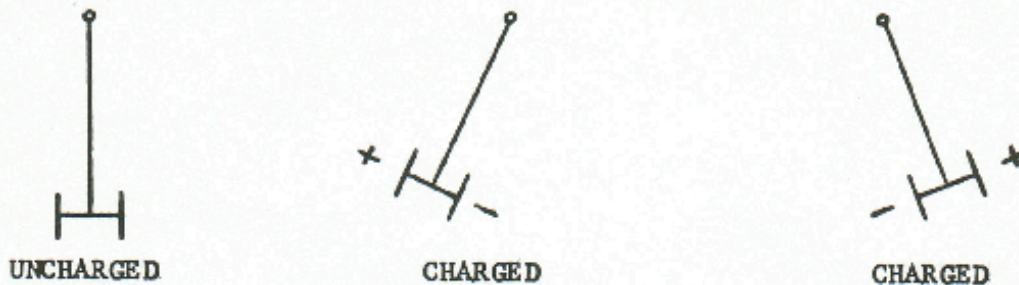


## GRAVITY EXPERIMENTS

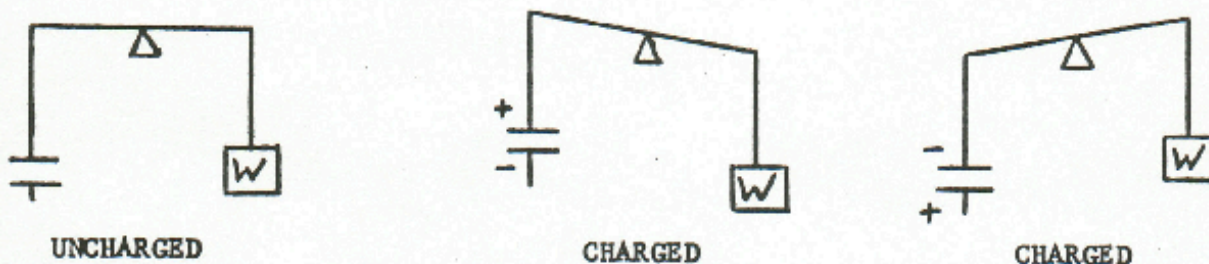
At the beginning of this report are noted a number of experiments which have seemingly shown some form of gravity control or closely related phenomena. These might be kept in mind as we delve into the various theories with the hope that something will mesh together and help us find our goal of a practical anti-gravity vehicle.

Some years ago, Professor Biefeld outlined to his student, Townsend Brown, certain experiments which led to the discovery of the phenomenon now known as the Biefeld-Brown effect. Further, these experiments helped to define the inter-relationship of electrical and gravitational fields. This coupling effect parallels electricity and magnetism. This means that from the technical and commercial aspects, the Biefeld-Brown effect has potentialities for future development and exploitation at least as great as the present electrical industry. Consider that electromagnetism is basic to electric generators and motors, power production and distribution, radio, television, radar, telephones, etc., and is indispensibly linked to all forms of commercial and other types of transportation. Then it can be easily seen that the possibility of a parallel development in the electrogravitation phenomena has almost unlimited prospects!

The original experiments conducted by Townsend Brown, as suggested by Professor Biefeld, concerned the behavior of a condenser when charged with electricity. The first startling result was that if placed in free suspension with the poles horizontal, the condenser, when electrically charged, showed a forward thrust toward the positive pole! When the polarity was reversed, it caused a reversal of the direction of thrust. The experiment was set up in this manner:



The gravity-control effect of vertical thrust is demonstrated by balancing a condenser on a beam balance and then charging it. Upon charging, if the positive pole is pointed upward, the condenser moves upward. If the charge is reversed and the positive pole pointed downward, the condenser thrusts down. The experiment is set up as follows:



These two simple experiments demonstrate what is now known as the Biefeld-Brown effect. This then is a method of controlling gravity for man's use. The intensity of the effect is determined by five known factors, namely:



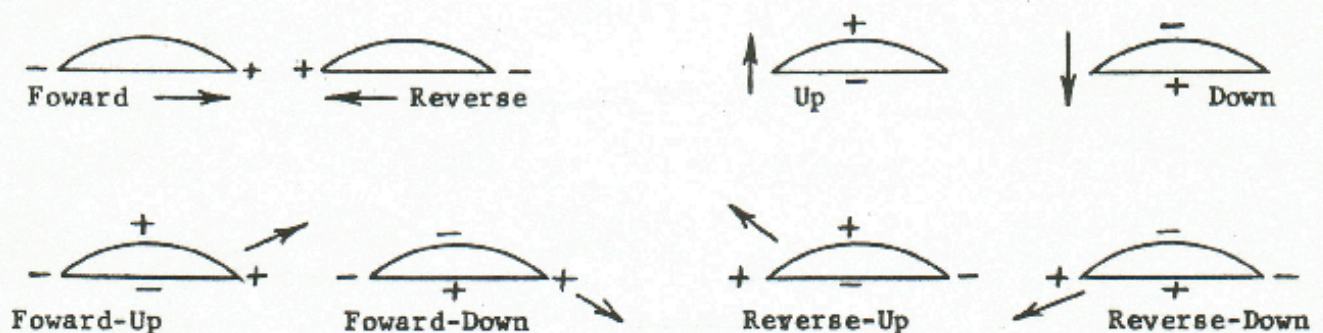
1. The separation of the plates of the condenser - the closer the plates, the greater the effect.
2. The ability of the material between the plates to store electrical energy in the form of elastic stress. A measure of this ability is called the "K" factor of the material. The higher the K, the greater the Biefeld-Brown effect.
3. The area of the condenser plates - the greater area giving the greater effect.
4. The voltage difference between the plates - the greater voltage, the greater the effect.
5. The mass of the material between the plates - the greater the mass, the greater the effect.

It is this fifth factor which is unexplainable from the electromagnetic aspect and which apparently provides the connection with gravitation.

Now that the basic concept of electrogravitation has been presented in the form of the Biefeld-Brown effect, we can now present the refinements necessary to accomplish the desired goal of a vehicle powered by gravity control.

The earth creates and is surrounded with a gravitational field which approaches zero as we go deep into space. This field presses objects and people to the earth's surface, and therefore presses our vehicle to the ground. However, thru the utilization of the Biefeld-Brown effect, our vehicle can generate an electrogravitational field of its own which modifies the earth's field. This field acts like a wave, with the negative pole at the top of the wave and the positive pole at the bottom. Our vehicle travels like a surfboard on the incline of a wave that is kept continually moving by the vehicle's electrogravitational generator. Since the orientation of the field can be controlled, the vehicle can thus travel on its own continuously generated wave in any desired angle or direction of flight.

The method of controlling the flight of the vehicle is illustrated by the following simple diagrams showing the charge variations necessary to accomplish all directions of flight:

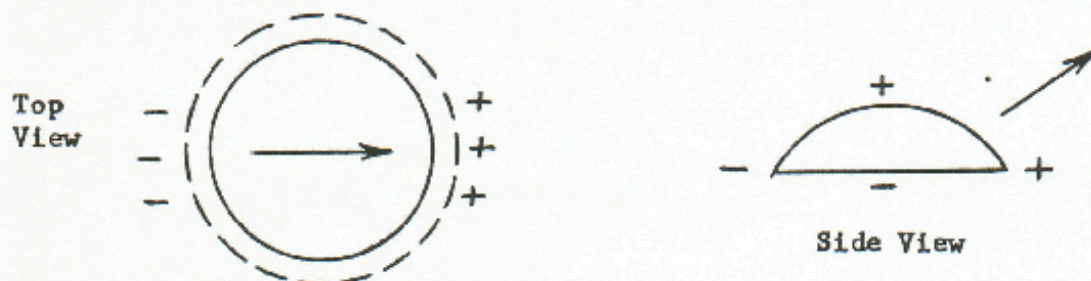


Since the vehicle always moves toward its positive pole, the control of the vehicle is accomplished simply by varying the orientation of the positive pole.



Control is therefore gained by switching charge position rather than by a conventional control surface. Since the vehicle is traveling on the incline of a continually moving wave which it generates to modify the earth's gravitational field, no mechanical propulsion system is necessary.

Once we understand that the horizontal and vertical controls are obtained by shifting the positive pole, then we are able to propose a finished vehicle design:



The upper plate is charged positive, and the lower plate negative to give direct lift. Condenser segments around the rim of the vehicle are used here to provide horizontal thrust and to change direction of travel. Many combinations of resultant forces are possible with this design resulting in a highly flexible flight mode. Both vertical and horizontal thrust would be regulated by varying the amount of charge to the respective positive plates.

In the course of his experiments, Townsend Brown developed a profile shape which would be most efficient to shape the electrogravitational field for maximum vertical thrust. The final profile that developed was the shape illustrated here:



Two Factors that might be of significance in improving the basic condenser effect are (1) stacking the condenser plates in series to create an additive effect and (2) varying the charging frequency to determine the optimum cycling for the most efficient thrust to power ratio.

Brown has stated that the occupants of a vehicle utilizing the Biefeld-Brown effect as a propulsion force would feel no stress at all, no matter how sharp the turn or how great the acceleration. This is because the ship and the occupants and the cargo are all responding equally to the wave-like distortion of the local gravitational field. In other words, all atoms in the immediate vicinity of the field receive an equal push instead of an externally applied force on each individual body as in all conventional transportation methods. Another advantage produced by the gravitational field surrounding the vehicle is that air particles are caused to move gradually away from the path of the vehicle instead of being suddenly thrust aside as in the case of a jet aircraft at supersonic craft.

An interesting experiment conducted by Dr. E. Saxl and reported in Nature magazine seemingly utilized the same connection between electricity and gravity that the Biefeld-Brown effect uses. In his experiment, Saxl placed a torque pendulum inside an electrified cage. The cage was electrically charged with voltages varying from 0 to 5000 volts. With these conditions, the period of the pendulum was noted to decrease as the voltage increased.



Since the period of a pendulum is directly proportional to the gravitational constant, the conclusion is that gravity was decreased within the statically charged cage.

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In 1959, Dr. M Pages proposed a theory (at the International Congress of Satellites and Missiles) wherein gravity is not caused by the attraction of the Earth, but is caused by the repulsion of the cosmos. Accordingly, the force which we call gravitation, he calls "sheer concentrated protonic energy". He supports his theory with a design of an anti-gravity machine which liberates itself from the force of gravity by an electric field rotating at the speed of light around the vehicle. This rotating field also suppresses mass inertia. This principle was tested successfully on small pieces of mica.

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An experiment was performed by Majorana in which he surrounded a measured mass with a sphere containing ten tons of mercury. He noted an apparent loss in weight of the experimental mass and concluded that the loss was due to an absorption of gravity waves by the dense mercury.

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Another experiment involving mercury entailed a test set-up wherein two weights were balanced on an extremely accurate scale balance. Underneath one of the weights, a quantity of mercury was caused to oscillate by a high-capacity pump. With the pump in operation, the balance indicated a minute loss in weight of the mass located above the mercury. The ratio of input energy (via the pump) to weight loss was impractically large.

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Possibly a combination of electrical energy and mercury could induce useable effects on gravity.

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The Foucault pendulum exhibits an effect such that the plane of the pendulum swing does not change. The apparent rotation of the plane is actually caused by the rotation of the Earth beneath the pendulum. Therefore the pendulum arc should show an apparent rotation of one cycle every 24 hours.

Maurice Allias conducted some remarkable experiments with some pendulums during which a cycle was found which was between 24 and 25 hours long. Allias's experiments were performed with a high degree of accuracy with continuous readings of about a month and in two widely separated locations.

Also, during a total solar eclipse, the plane of the pendulum swing was noted to shift approximately 15 centesimal degrees exactly at the start of the eclipse. Near the end of the eclipse, the plane again shifted and returned to the normal periodic cycle it had been following previous to the eclipse. This gives a very definite impression of a "screen" effect.

The abnormalities noted in the pendulum experiment are possible closely related with the abnormalities encountered in a number of observed dynamic phenomena, which have yet to be explained:

- (1) Abnormalities in the tide theory.
- (2) Size of the deviations to the south noted on falling bodies.
- (3) Variations in the amplitude of the deviations to the east noted on falling bodies.



- (4) Abnormalities noted in the action of terrestrial rotation on the flow of liquids.
- (5) Abnormalities noted in the motion of the horizontal gyroscope.
- (6) Various abnormalities noted in the geophysical measurements, ascribed until now to experimental errors.
- (7) Abnormalities is the oscillation of a pendulum noted by Pasteur.

To these abnormalities, which are dynamic, add the static types:

- (1) An apparent excess of gravity over the ocean and a deficiency above the continents.
  - (2) The abnormalities in the experiments of Newtonian attraction.
- There is some absorption of gravity (experiments by Majorana), but also - and mainly - a variation of the Newtonian force according to the medium where it is acting (Cremieu claimed that gravity forces act as though gravitation measured in water were greater than that computed by Newton's equation).

The accuracy of verification of the laws of gravitation are presently:

- (a) Astronomical - three parts in  $10^6$
- (b) Mechanics on Earth's surface (pendulum) - one part in  $10^5$ .

These figures are of the order of magnitude of the abnormalities noted in these pendulum experiments. From this, it will be seen that the abnormalities that have been found do not run contrary to the earlier experimental data, either on the surface of the Earth or even in the field of astronomy.

In the present status of known data, the abnormalities observed can be accounted for only by considering the existence of a new field.

Professor Weber has developed two basic pieces of equipment designed specifically to detect gravitational radiation.

Gravitational radiation sets up tensions and compressions within the bodies it encounters. These should be observable as fluctuations of the surfaces of the bodies, or as relative motion of two masses connected by a compressible link. The largest body available for such an experiment is the earth itself. If the earth is caused to oscillate by gravitational waves of external origin, this should be detectable on the surface as a fluctuation in the local value of the earth's gravitation. Dr. Weber's group has developed a gravimeter sensitive enough (a few parts in  $10^{11}$ ) to do the job, but so far the gravimeter has found nothing that looks like gravitational waves.

The second experimental system consists of two aluminum cylinders set up about a mile apart and tiltmeters and seismometers stationed close by. When the cylinders respond simultaneously and the tiltmeters and seismometers are not excited, this is called an event. They occur about once a month but nobody is yet willing to assign a definite cause.

A related experiment was performed with the two cylinders in close proximity. Vibrations in one cylinder were found to induce vibrations in the other by gravitational interaction at center-to-center distances just under two yards. What was involved was not gravitational radiation, but the dynamic field, equivalent to the electromagnetic dynamic field in which bodies respond to changing forces.



The dynamic field dominates interactions near the source. The dynamic field fades away rapidly with distance and leaves the radiation dominant. What was achieved was the gravitational analogue of an electromagnetic transformer, which induces currents in unconnected elements by means of an electromagnetic dynamic field.

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L. M. Stephenson describes a method of gravitational shielding that is already used to some degree. A body placed in a liquid having the same density as the body cannot be detected by any gravitational measurements. There is therefore an indication of a zero gravitational field. If two bodies are placed in the liquid (liquid and bodies of same density), there is no gravitational attraction between the two bodies. If this were not so, there would be gravitational convection currents within fluids.

A corollary of this is that if two bodies, each less dense than the surrounding fluid, are allowed to rise, their motion will be such that they will diverge more rapidly than the Earth's gravitational field lines diverge. Similarly, bodies of greater density than the surrounding fluid will sink and converge on each other.

The necessary conditions for perfect electromagnetic or gravitational shielding have similarities. In the electromagnetic case, the frequency being picked up by the detector (encased in a shield) must not be zero and the shield must have a conductivity which approaches infinity. In the gravitational case, the detecting body must have a precise density and the shielding liquid must have a compressibility which approaches zero. In both cases, the shielding effect exists only within the boundary of the shield and there are substantial interactions of the fields being shielded and the shield itself.

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During Edward White's extravehicular excursion while in orbit with the Gemini capsule, he noted a physical phenomenon which was unexplainable by Newtonian mechanics. He was able to rotate his body by extending and retracting his arms in a twisting motion. Newtonian mechanics says that the body should return to its original position once all motion has ceased due to conservation of angular momentum. If angular momentum is not conserved, then a device can be built around this principle to give a linear thrust for use as a propulsion system. A device like this has already been constructed and is known as the Dean Space Drive. Dean's mechanism uses a counterbalanced set of rotating eccentric weights. The axles of the weights are moved linearly by a solenoid during each rotation. Resultant thrust is produced in the same direction that the weights are moved. The weights are essentially made to change orbit, giving up momentum in each cycle to produce thrust.

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An experiment was performed in liquid helium whereby an open-mouthed bottle was placed in the liquid. A free-turning propeller at the mouth of the bottle was observed to rotate even though no liquid entered or left the submerged bottle. The theoretical vector force which caused this rotation might be another indication of a "dynamic" field.

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If a cup of liquid helium is suspended above a large container of liquid helium, the helium in the cup will flow up and over the side into the lower pool. This action will continue as long as there is a differential in the level of the two liquid surfaces.

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One phenomenon which may be noted as a common denominator throughout these experiments is the apparent existence and utilization of a "gravitational field" or "matter field". This field is akin to an electromagnetic field but so far has been shown to be associated predominately with matter. There are apparently two definable parts to this matter field, a close-up dynamic field effect and a long-range radiation field effect. The equivalents are demonstrated in an electromagnetic field.

If this matter field exists, and it seemingly does, it must be closely related to the well known electromagnetic field since matter and energy are considered interchangeable. The fields must then be connected by a certain set of functions such that one can be made to affect the other. The Biefeld-Brown experiments seem to utilize this connection most effectively while all the experiments give clues to the ultimate solution.

It is the author's opinion that the broadest application of gravity control will be a direct result of accurately defining the relationship between the matter field and the electromagnetic field. However, we do have the work of Biefeld-Brown to build upon as the initial forward surge into gravity control as a propulsion unit.

#### GRAVITY THEORIES

One of the original atomic theories, formulated by Father Boscovich, stated that the atom was a mathematical point surrounded by alternating zones of repulsive and attractive forces. This removes the duality of matter and a universal field. Actually, we do not directly experience atoms or the other theoretical entities of microphysics. What we do observe and measure and probe and use are the forces with which these hypothetical corpuscles are endowed. If all observable forces are manifestations of attraction and repulsion under different conditions, then it is logical to assume the conversion of one force into another where the proper conditions are present. Oersted utilized this logic in his long search for the magnetic effect of an electric current. Projecting this idea into the field of gravitational forces, we can readily surmise interconnections between gravity, electric and magnetic forces.

In a study pertaining to the study of the structure of elementary particles of matter, Einstein concluded that matter could be theoretically constructed from a gravitational field and an electro-magnetic field.

Einstein succeeded in formulating a set of equations which defined the inter-relationship of all phenomenon in the known universe. However, work is still being performed to convert his theoretical mathematics into practical tools.

The gravitational field of Einstein's theory is characterized by ten functions which vary in space and time. The gravitational field is influenced not only by the masses in motion but also by electro-magnetic fields. While a pure gravitational field can exist without an electro-magnetic field, a pure electro-magnetic field cannot exist without a gravitational field. The gravitational field is a "geometrical field", the electro-magnetic field is a "physical field".

Einstein reasoned that: If the forces of gravity can be replaced by the effect of the acceleration of a moving system, then they cannot be "real" forces such



as the pull of a winch. They must rather represent some geometrical property of a space-time continuum in which the motion of material bodies is taking place.

In order to explain the gravitation field which may be present in one place (near the sun) and practically absent in another (between the stars), it was necessary to introduce some geometric property which can vary from place to place. This brought Einstein to the idea of curved space varying in curvature.

Einstein argued that the motion of material bodies conventionally interpreted as being caused by the forces of gravity might simply be due to the curvature of the four-dimensional space-time continuum in the vicinity of massive bodies such as our sun.

We can illustrate how a varying curvature can take the place of a real physical force. Picture a rubber membrane stretched over the top of the water in a swimming pool. Assume a lead ball is thrown onto the pool cover, creating a depression in one area. If we were to roll a marble across the membrane, the depression will tend to deflect the marble's path from a straight line. Indeed, it may "capture" the marble, causing it to go into some manner of orbit around the lead ball. If we were to look at the pool from above, we would not notice the depression and would assume that the motion of the marble were due to an "attraction" between the marble and the lead ball.

In this illustration, the marble would create its own slight depression which would correspond to a simulated mass. In both cases, the slope of the surface of the depressions at any point is representative of the local force. The depth of the depressions should be relative to the amount of material that is in each of the bodies.

Of course, a theory is worthless unless it can be used to predict new effects which can be proved experimentally. Einstein not only was able to predict new effect, he showed how his theory could account for an observed abnormality in the orbit of Mercury (i.e., the excessive precession of the orbit not accounted for by Newtonian mechanics). Some effects predicted by the Einsteinian equations include: (1) The bending of light rays in a gravity field. This was later observed during a solar eclipse. Light is a form of energy and therefore must possess mass. Consequently, when light enters a gravitational field, it will, like any mass, travel in a curve. (2) The rate of time decreases as the gravity field increases. This effect was at first too small to detect on our sun, but was observable on high density bodies known as dwarf stars. Measurements were made by noting the frequency shifts of atomic radiations. (3) The increase in mass of a body as it nears the velocity of light. The evidence for this is well documented from experiments on particle accelerators. Electrons accelerated to a small fraction from the speed of light have been noted to increase in mass several thousand times. (4) The decrease in time rate on a body as it nears the speed of light. This again has been noted from experiments with particle accelerators. Nuclear radiations were the source of the measurements.

Einstein sought, in his final years, to derive the complexities of the entire universe in one unified theory, wherein the macrocosm and the microcosm - the giant wheeling galaxies of cosmic space and the micro-structure of the atom and all their various manifestations, would emerge. Mass and energy, particles and waves, matter and radiation, electromagnetism and gravitation - all would be



accounted for simply by changes in the structure and density of the primordial field.

Anti-gravity devices can be readily theorized from Einstein's theory of gravity. However, major breakthroughs are needed in theories and materials and energy sources before a practical anti-gravity device can be constructed.

Gravitational forces exerted by a body depends on both the mass of the body and its motion according to Einstein. Because of the gravitational effects associated with rotating or accelerated masses, in theory it is possible to build a machine that will set up a gravitational field in any direction. This field could then be utilized to counteract the Earth's gravitational field. As a propulsion unit, gravitational drive is very attractive from the standpoint of extremely high accelerations without any stresses on the vehicle or its occupants.

Some effects calculated from the Einstein theory are (1) Two pipes with a high-density liquid flowing at a high velocity through them in the same direction will repel each other from the gravitational equivalent of the magnetic "pinch effect", and two large, high-density rotating gyroscopes will repel each other if they are oriented properly.

An example of an anti-gravity device would be a unit of accelerated liquid mass whose flow can be equated to the electric current flow in a wire-wound torus. In this system, the mass flow through a pipe wound around the torus causes a field in the torus. If the flowing mass is accelerated then this field increases with time, the varying field then creates a bipolar gravitational field.

Unfortunately, in order to generate a force large enough to counteract the Earth's gravitational field, we need a mass of nuclear density accelerated at approximately  $10^{12}$  ft/sec<sup>2</sup> through a pipe hundreds of feet in diameter wound around a torus miles in diameter. This would still only last a small fraction of a second as the mass would rapidly reach the speed of light. So, obviously, a system based on this configuration is many decades in the future if possible at all.

Einstein's well known equation,  $E = mc^2$ , can be easily turned around to read  $m = E/c^2$ . A consequence of this transformation is that mass can be represented by energy. This then is a key to gravity phenomena since gravity so far has been shown to be related only to mass. The energy side of the equation may then represent the "second pole" of gravity. Gravity then being the one pole and the potential energy of the mass causing the gravity being the opposite pole.

If a mass is transformed into its energy equivalent, this energy is in the form of electromagnetic radiation. We might then explain gravity as the opposite pole of a "contained" or potential radiation. Another effect of this condition says that free radiation cannot produce gravity, but whatever causes radiation to tie itself into knots called mass also creates gravity!

A side effect of this relationship would help explain how gravity causes the bending of light rays as predicted in Einstein's theory and demonstrated by experiment. We should also consider the converse action of how light affects gravity. A consequence should be a method of controlling gravity by light waves.



Since energy and mass are equivalent,  $E = mc^2$  or  $m = E/c^2$ , a gravitational field must be associated not only with every mass but also with any amount or kind of energy!

The theory of relativity applies only to the macro world and does not apply to marginally small distances and time intervals. The theory of relativity is based on the continuum and hence can be expected to apply only to those scales in which the continuum concept applies. Also, there is a need for a maximal distance and a maximal time interval. Extrapolation of properties of space-time beyond these boundaries would be invalid.

Contrast between a space-time continuum and a quantum concept could possibly be resolved by (1) a hypothesis on the existence of a minimal discrete time interval; (2) a hypothesis of the existence of a gravitational mass of which all elementary particles are integer multiples. It is possible that gravitational waves could be quantized and the resulting quanta of gravitons would probably have a zero rest mass of a spin of 2.

Gravitational waves can possibly be divided into discrete energy packets, or quanta as electromagnetic waves are. Dirac obtained a solution whereby he quantized the gravitational-field equation and showed that the energy of gravity quanta, or "gravitons," is equal to Planck's constant,  $h$ , times their frequency - the same equation that gives the energy of light quanta or photons. However, the spin of the graviton is twice the spin of the photon.

The interactions of matter fall into distinct classes: (1) Nuclear forces; (2) strong interactions, which include electromagnetic forces; (3) weak interactions such as the "beta decay" of a radioactive nucleus, in which an electron and a neutrino are emitted; (4) gravitational interactions, which are much weaker than the ones called "weak".

The strength of an interaction is a function of the rate of the emission or absorption of its quantum. As an example, a nucleus takes about  $10^{-12}$  seconds to emit a photon. In comparison the beta decay of a neutron takes about  $10^3$  seconds. It can be calculated that the time necessary for the emission of a graviton by a nucleus is  $10^{60}$  seconds, or  $10^{57}$  times slower than the weak interaction.

Neutrinos are particles with an extremely low probability of interaction since they have no charge and no mass. In the weak interactions, neutrinos are emitted together with other particles. A process involving only neutrino has not been detected but they may occur, possibly on the same time scale as the gravitational interaction. A pair of neutrinos would furnish a spin of two (the same as the graviton). It is therefore speculated that there is a connection between neutrinos and gravity.

Einstein's equations have been solved by successive approximations. The third approximation then gives a small correction to the rest mass, which is found to be increased by the presence of other bodies. There is also a second order correction to the acceleration (not explicitly evaluated) which causes the perihelion advance in the two body problem.

All forms of matter move in space and contribute to the curvature of space-time



according to the laws of relativistic quantum theory and the law of the general theory of relativity.

Since in a real gravitational field, space-time is curved, the principle of equivalence cannot apply to large regions of space-time, and the loose formulation of the principle must be abandoned and replaced by a restricted and sharpened formulation: the principle of equivalence applies to the history of a small region of space, which is a thin tube in space-time; any physical experiment within a thin space-time tube in a gravitational field gives identical results, to the first order in the small lateral dimensions of the tube, as the corresponding experiment in a suitable thin tube in flat space-time free of gravitational fields.

The concept of a gravitational force disappears in a curved space-time theory of gravitation, and the gravitational field becomes the geometry of space-time. How is the gravitational field, the geometry of curved space-time, determined by its sources, the masses and concentrations of energy which produce the field? The curvature of space-time gives rise, in a natural manner, to interesting new possibilities in cosmology. The space of our universe can be finite in volume without having any boundaries, in much the same way in which the curved two dimensional surface of a sphere in ordinary Euclidean space has a finite area.

It is possible that gravitational mass causes the formation of a gravitational field and that the gravitational field causes the space-time to curve. The "general theory of relativity" is more correctly named the "theory of the curvature of space-time under the influence of gravitation".

In Einstein's concept of gravity, masses warp the space-time continuum in the immediate vicinity such that masses "fall" towards one another. If masses can warp space, it seems likely that an electromagnetic field can be set up which could also warp space, straighten it out if originally warped, or warp it in the opposite direction to any degree. The last two ideas result in gravity nullification and anti-gravity. This "space-warping" by an electromagnetic field is indicated from a transformation of the equation  $E = mc^2$  into  $m = E/c^2$ . This later equation is significant from the standpoint that it says that mass can be simulated by some form of energy and since mass causes gravity, some form of energy could likewise create the same effect. But since energy is a more flexible utensil, we should be able to "create" gravity in any direction and utilize it as a propulsion system.

Einstein's theory of relativity states that the effects of gravitation and acceleration are exactly the same. From this, one can realize a gravitational theory in which "gravity" is said to be produced by masses expanding in an accelerated manner. Thusly, the Earth, sun, solar system, galaxy and universe would all be expanding at some particular rate. Since everything observable would be in this state, no size changes could be detected. When it is considered that a charged nuclear particle (an electron, proton, etc.) should be tearing itself apart since like charges repel, an expanding mass can be readily visualized.

It is suggested that the inertial mass of a body depends not only on its rest mass but also on its velocity and on the character of its interaction with other bodies (e. g., on the magnitudes of the interacting electric charges,



whereas it follows from Einstein's gravitational equations that, except for the dimensional units, the ponderable mass of a body always equals its rest mass.

A section of Mach's principle states: Inertial forces originate in the acceleration of a particle relative to distant matter. Mach apparently had in mind a type of instantaneous action at a distance as the means by which very distant matter would produce this force. It would be more in keeping with modern notions of the nature of forces if the inertial force could some day be traced to a purely local interaction with the particles of a quantized field. This field would be assumed to have its source in all the matter of the universe. A particle at rest at the origin of a coordinate system in which distant galaxies are moving uniformly away from the origin would feel no force by reason of symmetry. However, an acceleration destroys this symmetry, and it would be expected that this distant accelerated matter would be a source of a gravitational field.

Mach's Principle views inertia as a dynamic gravitational effect due to the interaction of all the masses constituting the universe. Hence if a pail containing rotating water (and, with it, the earth and the apparently stationary ensemble of stars) is assumed to carry with it the reference system of coordinates, then the centrifugal force acting on the spinning body of water is attributed to outside forces. Mach concluded that the outside forces might be called either inertial or dynamically gravitational, the latter presumed to be due to an action of the masses of the universe with respect to which the body of water is spinning. On the other hand, if the reference system of coordinates is assumed to be fixed onto the water, then the body of water would have to be viewed as standing still, but the mass of the pail, the earth and the stars of the universe would spin about the now relatively stationary body of water and their dynamically gravitational pull would result in the formation of the same hollow surface which, under the previous assumption, resulted from the presumed inertial centrifugal action.

Inertial mass changes with the velocity of a body. Since gravitational mass is equal to inertial mass, it should also change with the velocity of the body.

Brans and Dicke have proposed a modification of the general theory of relativity whereby the familiar universal constant of gravitation ( $G$ ) would depend on the distribution of matter in space. The chief difference between universe models of the original general relativity and this modified one is that in this new model, the gravitational constant has been decreasing steadily ever since the early history of the universe. No definite conclusions have been made as to the validity of this change.

The Earth may be affected by the distribution of matter in the universe. Inertial forces might be considered as interactions with this distant matter.

The only relativistic means available to us for producing interactions between widely separated bodies are the long-range fields. The prototype of such fields is electromagnetism. The electrostatic interactions between widely separated separated charged bodies is well known; so is the fact that electromagnetic waves exist, propagating with the velocity of light.

The principles of relativity and quantum mechanics provide us with a rigid classification for long-range fields. All such fields may be divided into two classes, boson and fermion. The necessity for interchanging pairs of fermions makes it unlikely that long-range interactions will occur thru a fermion field.



When we are limited to boson fields there is a further classification provided by relativity. All such fields may be classified as scalar, vector, tensor, and higher-rank tensor. We shall assume that higher-rank tensors will not occur on the grounds that the mathematics are extraordinarily complex. The tensor field already provides enough mathematical difficulties. There is a long-range vector field that is associated with electromagnetism. Similarly, a long-range symmetric tensor field is believed to exist in the form of the gravitational field.

It is in connection with the tensor field that a direct relationship between inertial forces and the distribution of distant matter appears. It is found that the interaction of a tensor field with a particle leads to two different types of forces. One is a force proportional to the acceleration (inertial force). The other type of force is quadratic and is recognized as a gravitational force. Both types of forces may be called gravitational. Through the use of coordinate transformation, inertial forces may be converted into gravitational forces of opposite sign.

If it is only the position of matter relative to other matter that is significant, an absolute coordinate system in space should be without significance. If all coordinate systems (including time as a fourth coordinate) are of equal value, the mathematical tool appropriate for treating physical problems, including geometry, is the tensor calculus, since it is designed to treat geometry analytically but without reference to a specific coordinate system.

Dayton C. Miller, from 1922 to 1926, redid the Michelson-Morley experiment concluding "there is a positive, systematic ether-drift effect, corresponding to a constant relative motion of the earth and the ether, which at Mt. Wilson has an apparent velocity of 10 kilometers per second".

The sole reason for the speed of light entering into the equation of velocities of two physical bodies is required by the universal medium within which they move. This is ether under the disguise of light velocity.

Einstein's relativistic and Gerber's nonrelativistic theory furnish identical results. It is simply due to the fact that both theories are based on the assumption of ether, contained in the relativity implicitly, and stated by Gerber explicitly.

It would seem that ether gradients in some such form as a variable ether pressure and density distribution are much more likely to exist in view of the existing bodies ranging in size from nuclei to galaxies, which can be viewed as singularities in space structure. The origin of matter can, therefore, be investigated from the standpoint of localized ether stresses, i.e., ultimate ether quanta which enter into mutual relationship resulting eventually in such gigantic superstructures as electrons.

Possible structure of ether: The transmission of light shows that the ether must possess a structure exhibiting properties akin to rigidity and inertia. The rigidity may be understood hydrodynamically as a vortex circulation having a velocity of the same order as that of the transversal waves which the medium transmits. The inertia perceived in matter may then be an effect of the motion of electrons, atoms, molecules and microscopic bodies through ether. The granular structure of ether may be of a linear dimension of the order of  $10^{-30}$  or



$10^{-33}$  cm. But how the ether is tied into knots, we call electrons, remains to be discovered. The assumption that the formation and the existence of an electron sets up a radial tension all around it, accounts for gravitational and other phenomena.

In case of galactic and extragalactic distances, Newton's law breaks down if the vast spacial extensions contain masses of finite density. If, however, a kind of gravitational absorption in the universal medium as well as in the interposed celestial bodies takes place, then the difficulties in generalization of the gravitational law disappear if the Newton's equation is modified to read:

$$F = G \frac{Mm}{r^2} e^{-\alpha r}$$

where  $\alpha$  is the coefficient of gravitational absorption. In that case the motion of the bodies remains unaffected by very distant masses due to the complete damping of gravitational waves by means of energy absorption. In other words, if gravitational absorption exists, island universes should exist, a conclusion borne out by astronomical observations.

An experiment by Majorana gave a value of  $\alpha = 2.8 \times 10^{-12}$  per unit of mass acted on, per unit of density and per unit of thickness of the shielding mass. This experiment was performed by surrounding a measured mass with a sphere containing 10 tons of mercury and noting the apparent loss of weight of the experimental mass.

All the foregoing considerations have now prepared the ground for reviewing Arthur Korn's theory of gravitation based on the hypothesis of universal vibrations, a concept which ascribes to matter as property of atomic interaction due to subnuclear pulsations.

On the basis of the concept of universal vibrations as well as Bjerknes' experiments it is possible--according to Korn--to establish a theory of gravitation by making use of hydrodynamic analogy. To this end, Korn considers the results obtained by Bjerknes' experiments with pulsating spheres submerged in water. Two such pulsating sphere attract each other according to an equation analogous to Newton's law of gravitation providing that the phases of the pulsations are the same.

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A fundamental characteristic of all forces is that they exist in pairs. One apparent exception is gravitation. Each piece of matter contains the so-called "energy of constitution" of the value  $mc^2$ . This collection of energy/matter can be interpreted as being of a potential nature. Since the energy release of mass is in the form of radiation, we then call this particle of energy/matter potential radiation.

Possibly the above knowledge could be linked so that the outwardly directed potential radiation force of energy/matter is shown to be the counterforce of the inwardly directed force of gravitation. The author calculates the gravitational constant  $G$  from the potential radiation of a mass and finds that it agrees extremely well with the experimentally determined value.

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All matter is know to be potential energy. Since earth is matter, it is therefore potential energy. Since the earth is a source of energy, a vehicle operating as a connection between this source and an energy sink (free space) might be utilized as a space transportation unit.

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As we know today, all the elementary particles (electrons, atomic nuclei, etc.) exist in a continuously excited state, and pulsate, i.e., oscillate. And since their oscillations or pulsations take place in a gravitational and electromagnetic field, obviously each such pulsation is accomplished by the emission of a certain amount of energy. Now, this "certain amount" of energy that is emitted possesses a certain mass. And it is this elementary "certain amount" of "energy-mass" that we call a graviton.

Let us imagine two spheres some distance apart. Let us think of these spheres as bodies consisting of pulsating elementary particles--particles which continuously radiate gravitons in all directions. The flying departure of each graviton imparts to the body from which the graviton departs, a reactive "thrust" in the directional sense opposite to the departing graviton's own sense. But since, as we have noted, gravitons are departing from or flying out of the body in all directions at once, the body itself does not feel or show the effect of any such reactive thrust or, to state the matter more precisely, the many reactive thrusts thus imparted to the body which impel it in so many different directions at the same time, simply cancel one another out. Now, if we assume that the number or quantity of gravitons emitted into a space already relatively saturated with gravitons will be necessarily smaller than the number or quantity emitted into an empty space, then, presumable, by moving two bodies closer together we shall destroy their relative equilibrium, since obviously the space between the two bodies will become relatively saturated with gravitons, and, consequently, the number or quantity of gravitons emitted into that space will grow smaller. thereupon, the relative equilibrium of the two bodies will be destroyed, and they will start to move closer together, to be drawn toward each other, impelled by the combined reactive impulses or "thrusts" imparted to them by the the "outwardly" departing gravitons.

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Physical conceptions of gravitation as a force that is caused by nuclear radiation should not be considered as seeking to supercede the general theory of relativity. The general theory of relativity is concerned only with interactions between huge volumes of matter. Therefore, the conceptions mentioned above tend rather to supplement or complete the general theory of relativity.

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A planet in a gravitational field can be regarded as absorbing gravitational quanta that are emitted by the central star. These gravitational quanta carry gravitational momentum and energy, just as electromagnetic quanta carry electromagnetic momentum and energy. We can visualize the sun as continually throwing out and reabsorbing gravitational quanta, producing a steady state of the mean number of quanta present in space. If we imagine that a planet can absorb quanta only when they are returning to the sun, we see that an inward force is produced by an enormous number of tiny impulses. The planet also emits quanta which are absorbed by the sun. Thus the two bodies attract each other, and energy is conserved. The force is constant due to a large number of impulses in a short time.

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There is a hypothesis that all bodies emit "portions" of gravitation and the intensity of the emission of gravitons per unit of mass depends upon the tension of the external field of gravitation. Evidently, gravitation field intensity between two bodies will be greater than outside of them. The same may be said about the pressure of the gravitation field. Visualize two bodies emitting particles equally in all directions. Between the two bodies the additive effect results in a higher density of particles. Therefore, the energy of gravitons radiation will depend upon the direction in which they move. When gravitons move into a medium with a great field counterpressure (that is, between bodies) the energy of radiation will be lower than when the radiation is emitted into vacuum. Thus, under unsymmetric radiation (in the sense of distribution of energy) a resultant force will arise leading to the approximation of attraction of bodies towards each other.

Besides the reactive force which arises in cases of uneven radiation of gravitational energy, the difference of pressure forces of the field exerts its action upon bodies. Since the pressure of the gravitational field between two given bodies is greater than the pressure of the field outside of them, these bodies are not only attracted to but also repulsed from each other. Under ordinary astronomical and physical conditions the forces of repulsion are insignificant in comparison with the forces of attraction. However, it may be supposed that in cases of very compact matter (of the order of  $10^{14}$  grams per cubic centimeter) the tension and pressure of the gravitation field or gravitation medium may also be very great so that the magnitude of the forces of repulsion becomes comparable with the forces of attraction.

Gravitation can be attributed to the impact of numerous small particles. All bodies are continuously exposed to impacts by these particles. All impacts received by a single body in space would balance out, but, when there are two bodies, there is no longer an equilibrium between the impacts, since either body shields the other from the impacts of the particles traveling along the line that connects the centers of the two bodies. Thereupon the two bodies will be pushed together. And, since bodies of greater mass intercept more particles they experience greater gravitational forces.

Alzofon seeks to explain the gravitational field as an averaged fluctuating electromagnetic field generated by the creation and annihilation of charged particles on a subatomic scale. This can be considered since a given mass may be electrically neutral on a macroscopic scale, it will not be so on a subatomic scale. Creation and annihilation processes are incorporated into physical theory in a fundamental manner by altering the concept of a light signal to include these processes as fluctuations. Because the space-time metric is quadratic, a root mean square effect is generated which allows description of matter and radiation by a single field. The force field generated by creation-annihilation processes is shown to be attractive, proportional to the mass of the source, and inversely proportional to the square of the distance of separation of source and test body. The law of force changes when the particles approach one another to within a distance of the order of magnitude of the Compton wavelength. The red shift observed in the light received from distant galaxies can be explained in terms of the proposed model in terms of particle creation, rather than as a Doppler shift.



The following items were considered in this theory:

- (1) The gravitational field exists wherever masses exist; no permanent electric charge need be present, whence it follows that the gravitational field is different in origin from the electromagnetic field.
- (2) The gravitational field is proportional to the mass of the body producing it, and since all of the mass of any object is concentrated in atomic nuclei and electrons, it is suggested that processes characterizing these are responsible for the field.
- (3) Processes occurring in the nucleus and in the neighborhood of elementary particles are distinguished from those producing electro-magnetic forces in that creation and annihilation is not a consequence of the interaction between source and electromagnetic field. Instead, it is assumed that such processes are an intrinsic part of the motion of the real electromagnetic field. The average effect of a great number of creations and annihilations is the electromagnetic field described by the Maxwell equations and propagated with velocity  $c$  ( $c = 3 \times 10^{10}$  cm/sec). It is assumed that creation and annihilation processes proceed without cessation.

It is suggested that one has now obtained a field which exhibits the properties of radiation (in the Maxwell sense) and of matter as different aspects of the same field. Einstein's relation between energy and momentum is preserved for a particle at rest, and approximately so for particles at "low" velocities. For energies much greater than the rest mass of the particle, one must expect to see departures from Einstein's relation owing to the creation and annihilation processes which then begin to dominate the motion.

The existence of particles as an integral part of the real electromagnetic field leads to the conclusion that those particles are effectively bound to the field. Yet it seems likely that there remains a small probability of the particles leaking away from the bound state. In particular, a ray traversing interstellar space would thereby lose a measurable energy. The effect can be calculated and shown to be precisely the same value as the red shift customarily presumed to indicate an expansion of the universe. Also, since a light signal is accompanied by a complex structure of virtual processes, there should be an attractive force between it and a material body.

It is absolutely indisputable that bodies lose mass and energy when they emit gravitons or gravitation waves. At the same time, two gravitons may collide and form another pair of "fundamental" particles, for instance, an electron and a positron. If we accept this view, correction will have to be made to the equations of all theories of gravitation as a result of which it appears that the force of gravitation will diminish more rapidly in proportion to distance. This additional diminishing of forces of gravitation in proportion to distance is quite sufficient to explain Seliger's paradox (External gravity forces on a star is an infinite amount, so total force is indeterminant).

The stars are steadily converting their mass into radiant energy and the sun actually radiates four million tons of its substance into space every second. The Earth and the planets intercept a minute fraction of this radiation, the bulk of which travels on into space. Similarly,



the radiation from billions upon billions of other suns has been pouring into space, so that "space" is never really empty. What effect, if any, does this large amount of ejected matter play in the mechanism of gravity? Also, does this ejected mass reform again to create new galaxies and suns and planets?

Possibly this radiation by some natural mechanism forms into simple matter (hydrogen atoms) and then evolves into higher and higher matter forms, culminating in a solar system whose sun again radiates the matter back into space as energy. To be useable to man, this radiation energy could be converted directly into an electrical current or first changed to simple matter such as hydrogen atoms. In this form, conversion to useful work is a relatively simple task and results in a highly flexible tool.

It is almost certain that all universal space is predated by electrical, magnetic and gravitational currents flowing from areas of higher potential to areas of lower potential. It then seems likely that a space vehicle could utilize these currents for navigation between planets, stars or galaxies much as a sailboat takes advantage of ocean and wind currents for propulsive power.

Schiff accounts for gravitation by assuming that it comes from the exchange of neutrinos between any kinds of matter. Neutrinos are nature's "ghost" particles, having no electric charge and virtually zero mass.

Scientists have suggested that gravitational force might resemble electromagnetic or nuclear forces in that the last two arise from the exchange of some kind of particle between the interacting objects. Electromagnetic forces arise from the interchange of light quanta, or photons, between electrons or protons, and nuclear forces arise from the interchange of pi mesons between neutrons or protons. Previously, the idea that gravitational forces could arise from the interchange of neutrinos could not be made consistent with Eotvos experiment (weight/mass = 1). Schiff modified the theory to account for this.

Stanyukovich has theorized that lowering the temperature of matter to absolute zero would lead to a considerable decrease in gravitational forces and possibly their disappearance, thereby creating "weightless matter".

He has also constructed a theory in which the gravitational field of ponderable masses is caused by superhigh-frequency (multi-billion-cps) vibrations of matter and by the ejection - from the vibrating body - of energy in the form of gravitational quanta or "gravitons". He states that this gravitational radiation would be more intense at high temperatures and, conversely, reduced virtually to zero at low temperatures, near absolute zero.

Other scientists believe there are energy-carrying gravitational waves which can be quantized into energy quanta, hypothetically named "gravitons". However, they consider the amount of energy transported to be small as to be a negligible aspect of gravitation. Thus, even a total elimination of gravitational-wave quanta or "graviton transmission" could not effect an annihilation of gravitation.



According to the Stanyukovich hydrodynamic hypothesis, bodies emit gravitons into their surroundings; when two bodies are in the vicinity of one another, the graviton density accumulating between them slows down the emission of gravitons in the interadjacent space, whereupon the thrust of the graviton radiation over the outer portions of the two bodies prevails and exerts a resulting force of attraction between the two bodies. It follows from the basic premises of the theory that any reduction of the intensity of the creation of graviton particles (possibly at extreme low temperatures) would weaken the gravitational field produced by the resultant field fluctuation.

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The magnetic properties of a superconducting metal may be described in the following manner; At no time can a magnetic field penetrate into the depth of a superconductor. That property takes place regardless of the conditions in which the transition to the superconducting state has actually occurred. Thus, if the cooling of a specimen is performed within a magnetic field, then at the time of transition the magnetic lines of force are expelled from the body. The electrical properties (the absence of an electrical resistance) are merely inescapable consequences of the magnetic properties. This consideration might suggest the possibility of a similar expulsion of the gravitational field from a body but only provided that a fundamental similarity between the magnetic and the gravitational field were proved to exist.

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Connected electron pairs, hence, the phenomenon of superconductivity at extremely low temperatures--are contingent on the presence of an attraction, no matter how small, to overcome the repulsive Coulomb interaction between the electrons. In this particular instance, the question of gravitational action at intra-pair distances may have a decisive effect on the delicate force balance obtained there. It is quite possible that gravity plays a role in the elementary particle scheme. It was at first felt that gravitational forces were "too small" to serve as the stabilizing force in the atomic nucleus, but further developments in elementary particle physics may change our concepts regarding space and time at extremely short distances.

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How essential is gravitation in the physics of elementary particles? If gravitational waves exist, then transmutations of gravitons into electrons, positrons, and photons must also take place. The exceedingly small value of the universal quantum gravitational length (about  $10^{-33}$  cm) indicates, that gravitational forces can hardly be consequential in the structure of elementary particles.

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In connection with the description of gravitation and electromagnetism in terms of space-time geometry exclusively, attempts are continuing in the development of a geometry that will satisfy the requirements of gravitational and unitary theory in the large and that will become quasi-Euclidean in the ordinary scale of human life and activity.

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Shaw tested for a temperature effect on gravity to an accuracy of two parts in one million per degree centigrade. He found no connection. Comets heat up considerably when passing close to the sun so they should deviate from their predicted course if there were some connection between temperature and gravity.



They have shown no course deviation that could be attributed to temperature effects. This test is of an even high degree of accuracy than Shaw's

Many crystals exhibit different physical properties in different directions. Experiments have been made to see whether or not crystals show any change in weight when they are differently oriented with respect to the Earth. This has produced negative results to one part in one billion. Weighing pieces of steel in a magnetized and in an unmagnetized condition has also given negative results.

The "weak" force involved in the radioactive decay of atomic nuclei is stronger than gravity by a factor of  $10^{25}$ ; the electromagnetic force which holds atoms and molecules together, is stronger by a factor of  $10^{37}$ ; and the nuclear force which holds atomic nuclei together, is stronger by a factor of  $10^{39}$ . On the astrophysical scale however, the gravitational pulls of high numbers of atoms ( $10^{57}$  in the case of the sun) combine efficiently to form one gigantic pull, whereas none of the other three forces can combine efficiently to create forces much beyond atomic dimensions. As we examine nuclear, electromagnetic, weak and gravitational interactions, we find them to decrease in intensity and increase in universality in that order.

The calculation of the relative strength of the electrostatic and gravitational forces between a pair of particles (assume pi mesons) shows that the ratio equals the square of the charge on an electron divided by the square of the mass of the particles times the gravitational constant ( $e^2/m^2 G$ ). For two pi mesons the value is  $10^{40}$ . Any theory relating electromagnetism and gravity must explain this ratio.

Dirac has proposed that the large ratio of electric to gravitational forces is characteristic of the present age of the universe. He assumes as a unit time the time required for light to traverse the radii of the average particle. The radii is assumed to be  $3 \times 10^{-13}$  centimeter and since the velocity of light is  $3 \times 10^{10}$  centimeter per second, the elementary time unit is  $3 \times 10^{-13}$  divided by  $3 \times 10^{10}$  or  $10^{-23}$  second. The age of the universe expressed in terms of this elementary time unit is about  $10^{40}$ . Dirac then claims that gravity is decreasing as the universe expands and the matter is rarefied.

The principal characteristic of electromagnetic radiation is that when radiation is produced, the radiator loses an amount of energy which is independent of the location of the absorbers. With gravitational radiation, on the other hand, it is still not known whether a gravitational radiator transmits energy whether there is a receiver near or not.

The power radiated by the solar system in the form of gravitational waves is approximately  $10^{24}$  times less than that radiated electromagnetically, and is about one kilowatt. Therefore, it is possible to neglect the action of gravitational radiation waves in all but purely theoretical calculations. This result shows that the problem of the motions of systems of gravitating masses may be considered as a problem in mechanics, disregarding radiation.



Zwicky has discovered that Newton's universal law of gravitation is not universal, but that it breaks down if the interacting bodies are separated by distances greater than about five million light years.

Until recently, no real evidence was ever presented that Newton's law holds for separations of masses which are greater than about a light year, or for bodies located outside a radius of 700 light years from Earth.

From counts of galaxies in many galaxy clusters, it was possible to determine the following:

1. Many of the galaxy clusters are spherically symmetrical, with axial fluctuations lying well within the limits expected.
2. The 500 brightest galaxies of a cluster show a radial distribution which is adequately represented by equations for an isothermal gas sphere.
3. There appears to be a marked separation of bright and faint member galaxies in a cluster, an effect which is expected to exist in stationary swarms.
4. The structural features are the same for spherically symmetrical clusters at all observable distances.

These four observations prove that Newton's law, with a fixed value for the universal gravitational constant, adequately describes the interactions between large masses such as galaxies, if these masses are not separated by distances greater than the radii of large clusters of galaxies, about three million light years.

Some strong evidence has come to light which indicates that the law breaks down when the interactions between clusters of galaxies, rather than galaxies, are examined.

If the law is universal, we should expect the clustering of galaxies to be unlimited. Actually, however, the largest spherically symmetrical clusters found among the 10,000 clusters searched are very similar, and all are of about the same size and population. Thus, there seems to be a limit to the size and population of stationary and geometrically well-organized clusters.

If the law is universal, we should also expect to find clustering of clusters of galaxies. Investigations have shown, however, that this is not the case.

It has been observed that the 100 nearest clusters are distributed in space with remarkable uniformity. There is no close pair or multiples among them. In sharp contrast to this is the fact that there is hardly a single galaxy among the 100 nearest or brightest which is not bunched with other galaxies in groups of two or more.



It has been demonstrated that the 10,000 observable galaxy clusters are distributed uniformly and randomly, both in breadth over the sky, as well as in actual depth of space, as if they were completely noninteracting objects. As a result of these observations, we must conclude that Newton's law of gravitation seriously breaks down when the interacting masses are separated by distances greater than about five million light years.

Assuming this lack of interaction at great distances to be true, we are faced with several serious consequences. First, the general theory of relativity will require some revision since the theory is based on field equations which are adjusted, at their limits, to Newton's law. Secondly, all conclusions about the evolution of the universe and its supposed expansion will need reanalysis.

All matter is composed of elementary particles, most of which are charged. Electric forces between charges and gravitational forces between masses are both long range, i.e., they fall off with the square of the distance, rather than exponentially like the short range nuclear forces. Between two charged elementary particles the electric force is tremendously stronger than the gravitational force--by a factor of the order of  $10^{40}$ . Why then do not electric forces predominate on the astronomical and cosmological scale? The answer is, of course, that electric charges of both signs appear in nature, that they "shield" one another, so that matter in the large is electrically neutral.

Gravitation charge or mass, however, is always positive. This is why gravitation is important on the large scale.

Gravitational polarization, which could make possible a gravity "shield" requires that there be two types of matter, some with positive gravitational mass and some with negative gravitational mass. As of yet particles with negative mass are unknown. The mass of antimatter or antiparticles has proved to be of a positive sign thereby providing no help for a gravity "shield".

It is theorized that a light ray would be polarized when passing through a gravitational field (in addition to the well-known "bending"); also, it is suggested that an electromagnetic field (light) would excite gravitational waves of the same frequency.

There is the possibility of a force field of different origin counteracting the gravitational forces acting on a given body. A metal sphere can be levitated by an electromagnetic field produced by wire loop with little expenditure of power if the coil is kept below critical superconductive temperature. Also, the radiation pressure of photons ejected by an intense thermonuclear process can overcome the gravitational force acting on particles and drive them away from the center of radiation. As an example, comet's tail is "blown" away from the sun while heavier particles are sometimes attracted out of comet core into the sun.



Assume the "orbital" type of atom structure. Electrically, the most significant particles of the atom are the proton and the electron. The electrical charges are of equal value but of opposite sign. A third characteristic is that the proton and electron are not located at the same point in the atom. They are separated by a distance known as an orbital radius. They therefore cannot act in an equivalent and neutralizing manner on an external body! This differential, however slight, might be exploited by an electrically charged body, properly manipulated to repel one atom or a collection of atoms (planet) to produce a space propulsion system. This system would probably require an electromagnetic radiation whose wavelength is equal to the average orbital radius of the atoms from which it is repelling itself. Possibly, this slight differential in particle location is the basis of the force called gravity.

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One method of electromagnetic propulsion proposed but not yet tested is this: A transmitter, feeding through a directional antenna would produce a "blown off" electromagnetic wave. The succeeding wave would be formed such that the direction of the electrostatic charge in the wave directly opposes the electrostatic charge of the first wave (i. e., positive to positive or negative to negative). In this manner, it is speculated that the antenna would "propel" itself (and any connected body) by "pushing" against its generated waves.

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For each mass, there is a gravitational radius beyond which a collapsing action cannot be halted. Once this size is reached, no energy can be released from the mass in any form (light or otherwise). A star undergoing a gravitational collapse would disappear from view very suddenly. Externally, the gravitational field would still exist but with no apparent origin. An object allowed to fall into this field would fall normally until the gravitational radius were reached at which time it too would become invisible.

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The mass that has undergone gravitational collapse theoretically is squeezed to almost infinite density and zero volume. However, R. Penrose pictures one way in which the matter might escape being crushed. There might be a space-time "warp" or "hole" created by the gravitational collapse through which the matter could flow without being crushed to zero volume. The matter might then emerge in some other region of our own universe or in some other universe!

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As pointed out, at a highly concentrated gravity level, light cannot escape its source. From outside the system, nothing is detected. This suggests a method of containing large amounts of energy by intense, artificially generated gravity fields. This would be an ideal "bottle" for a nuclear fusion process.

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Assume a 3-dimensional rod passing through a fluid 2-dimensional plane; the rod slightly sloping from a perpendicular direction to the plane. As the rod passes through the plane, on the perpendicular, an observer within the 2-dimensional plan sees only a circular mass moving along in his 2-dimensional world.

Therefore, projecting this idea into our world of 3-dimensions, making the rod 4-dimensional extending into the "time" dimension, we see that possibly all that has ever come into being or will come, co-exists, which passing slowly on, leaves in our consciousness, limited to a narrow space and a single moment of "time" a record of change.